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RICE ECONOMY OF KERALA

A DISAGGREGATE ANALYSIS OF PERFORMANCE

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CONTENTS

1. INTRODUCTION

Rice is the most important food crop of Kerala accounting for about 28 per cent of the total cropped area and for more than 99 per cent of the production of cereals in the State. Between 1960-61[1/] and 1983-84, the area under rice declined from 778,913 hectares to 740,086 hectares. However, this period witnessed a gradual increase in the cropped area until 1974-75 when the area reached a peak level of 881,466 hectares before the decline had set in.[2/]

Between 1960-61 and 1974-75,[3/] area under rice increased at an annual compound rate of 1.14%; yield increased from 1371 kgs/ha to 1513 kgs/ha indicating a low annual growth rate of about one per cent; and production increased at an annual compound rate of about two per cent. Between 1975-76 and 1983-84, the growth rate of area turned out to be negative (-1.5%). Inspite of a slight improvement in the growth rate of yield as compared to the previous period, because of the fall in the area, production remained more or less stagnant throughout the second half of the 70's. The production of rice in 1983-84

1/ Though Kerala State was formed on November 1, 1956, the statistical base for the state was properly organised only from 1960-61.

2/ Panikar (1980) had pointed out that since 1974-75, when the crop acreage touched the peak level, the total area has steadily fallen. The decline was observed in both the main seasons (autumn and winter) with slight increase in summer. In the years subsequent to Panikar's study a decline was observed in all three seasons.

3/ Throughout this study the period 1960-61 to 1974-75 will be referred to as the first period and 1975-76 to 1983-84 will be referred to as the second period. The periods were chosen because (1) 1974-75 has the peak area under paddy and (2) 1974-75 marks the end of the estimates based on land utilisation surveys and from 1975-76 the scheme for Establishment of an Agency for Reporting Crop Statistics (ERCS), commonly known as T.R.S., was introduced.

was only 1.21 million tonnes against the peak production of 1.37 million tonnes in 1972-73. This is somewhat different from the all India pattern where agricultural growth in the seventies was much faster than the performance in the Sixties.[4/] It is sometimes argued that in Kerala probably the sixties was a period of accelerated growth and the Seventies, especially after 1974-75, was a period of decelerated growth.[5/]

The decline in area was attributed to a number of factors such as the reversal of the rising trend in paddy price from 1974-75 and increased cost of production.[6/] Along with this trend in relative prices yield increase was only marginal, and the relative profitability of rice had become unfavourable. The poor performance of rice production in Kerala was also attributed to a number of constraints such as diverse agroclimatic conditions, acidic soils, uneven distribution of rainfall, soil erosion, multiple cropping, high incidence of pests and diseases, and low level of fertiliser use.[7/]

Most of the available studies on rice in Kerala are based on data aggregated over seasons and over space, such aggregations might

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4/ See Alagh and Sharma (1980) and Rath, Nilakanta (1980).

5/ See P.P. Pillai (1981)

6/ For example, Panikar (1980) has concluded that the overall improvement in supply position, reflected in the steep fall in price of rice, as well as the rise in the cost of cultivation has brought about the unprecedented decline in area under rice since 1974-75.

7/ See V. Thyagarajan and N. Trivikraman Nair "Rice Production in Kerala - Its Data Base and Data Gaps", 1981 (mimeo) conceal some of the inherent trends in the disaggregated data by mutual adjustments of the positive and negative trends. In particular, the observed stability in production of rice in Kerala may not be uniformly spread over the three seasons and over the different spatial regions of the state.

2. OBJECTIVES AND SCOPE OF THE STUDY

The main objective of this study is to carry out a dissaggregated analysis of the rice economy of Kerala. The specific objectives included the following:

(1) to analyse the trends in area, yield and production of rice during the three seasons in the important rice growing districts.

(2) to analyse the variability in area, yield and production over the seasons in the different districts.

(3) to estimate the contributions of area and yield in explaining production changes.

(4) to analyse the factors influencing changes in area, yield and production.

As pointed out earlier, paddy is grown during the three sesons of autumn (Virippu), winter (Mundakan) and summer (Punja).8/ The changes in area, yield and production during the three seasons and for the combined seasons were analysed. Though the most appropriate procedure to study spatial divergence might have been an analysis based

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8/ During 1983/84 the shares of area in autumn, winter and summer seasons were 44.3%, 43.9% and 11.8% respectively and the production shares were 43.1%, 43.1% and 13.8%

on the agro-climatic zones, existing data base did not permit such an analysis. However, since there was some correspondence between the agro-climatic zones and revenue districts, it was decided to use the existing district level data for the spatial analysis. Among the 14 districts in the state three were formed only recently and some other districts had limited area under paddy. Considering the availability of data and the importance of rice in the cropping pattern of the district it was decided to include Trivandrum, Quilon, Alleppey, Kottayam, Ernakulam, Trichur and Palghat districts for the detailed analysis.[9/]

Grwoth and stability of output were two important concerns of agricultural development policies in India. As pointed out by S.R.Sen,[10/] C.H.H. Rao[11/] and others, measures adopted for achieving growth in agricultural production through extension of area under crops and intensive use of inputs, especially the HYV, have often resulted in increasing the annual fluctuations in production. Though rice production in Kerala has not witnessed any major breakthrough as in the case of HYV wheat in the north, the changes in the production system over the period might have influenced annual fluctuations in area, yield and production. In this study annual variations in area, yield and production are measured using the coefficient of variation[12/] for each period separately and for the combined period in order to identify

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9/ These districts accounted for more than three-forth of the area under paddy in Kerala.

10/ S.R. Sen (1967)

11/ C.H.H. Rao (1975)

12/ Ratio between the standard error of the estimated function and the mean of the estimated trend value expressed in percentages was taken as the coefficient of variation.

the nature of changes in stability over seasons and regions.

Various attempts were made in the past to decompose the changes in output levels according to area, yield, cropping pattern and interactions[13/] using additive or multiplicative decomposition of the annual changes in production with a view to identify the dominant factor influencing annual changes. The results obtained from the analysis of annual changes were compared with the results based on changes during the interval.

The analysis of the contributions of area, yield and interactions in explaining production changes is followed by an analysis of the contributions of major factors influencing changes in area and yield. The role of relative prices of paddy and coconut in explaining changes in area under paddy was investigated. Among the factors responsible for yield increases, the role of high yielding varieties, irrigation facilities, and government expenditures for improvement of paddy production were considered.

3. TRENDS IN AREA, YIELD AND PRODUCTION

Of the total area of 740,086 hectares under rice during 1983-84, 44.3% was cultivated in autumn, 43.9% in winter and 11.8% in summer. The share of autumn rice was slightly more than half the total area under rice in the beginning of the 60's but this share gradually declined until the middle of the 70's. Further, the area under autumn rice was higher than the area under winter rice until 1974-75, but in

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13/ See for example Minhas and Vaidyanathan (1965), Vidyasagar (1980), Dharm Narain (197-), and V.M. Dandekar (1980).

a majority of years in the subsequent period area under winter rice exceeded the area under autumn rice. The area under summer rice accounted for 10 to 13 per cent of the total area under rice.

The average yield of rice increased from 1,371 kgs/hectare in 1960-61 to 1,632 kgs/hectare in 1983-84. The maximum yield during this period was 1,678 kgs/ha in 1982-83 and the minimum was 1,243 kgs/ha in 1965-66.

Seasonal variations in yield indicated a range between 1148 kgs/ha in 1961/62 and 1689 kgs/ha in 1982-83 for autumn, between 1188 kgs/ha in 1965-66 and 1655 kgs/ha in 1981-82 for winter, and between 1,122 kgs/ha 1965-66 and 2,316 kgs/ha in 1971-72 for summer. During 1960-61 to 1982-83, the highest yield per hectare was recorded for the summer crop in 18 years, for the autumn crop in 3 years and for the winter crop in one year. The autumn crop had the lowest yield only in one year. In terms of the ranking of yield levels during these 23 years, the combination SWA of highest yield during summer (S) followed by winter (W) and the least in autumn (A) was observed in 15 years. The frequency of other combinations were; SAW in 4 years, ASW in 2 years, AWS in one year, and WSA in one year.

The season average was greatly influenced by the performance of the summer crop. During the 23 years considered here summer yield was above the annual average yield in 21 years and only twice it was below the average. During the winter season, yield levels were below and above the annual average in equal number of years (11 years) and exactly the same in one year. Autumn yields were below the annual average in 19 years and were above the annual average in only 4 years.

Table 1: Share of Autumn, Winter and Summer rice in the total area under rice

Year	Percentage area under Autumn rice	Percentage area under Winter rice	Percentage area under Summer rice	Total area (1000 hectares)
1960-61	50.9	39.4	9.7	779
1961-62	48.6	41.5	9.9	753
1962-63	49.4	41.0	9.6	803
1963-64	49.4	41.0	9.6	805
1964-65	49.3	41.1	9.6	801
1965-66	49.6	40.9	9.5	802
1966-67	49.6	41.0	9.4	799
1967-68	49.3	40.4	10.3	810
1968-69	45.2	43.6	11.2	874
1969-70	45.0	43.7	11.3	874
1970-71	45.2	43.7	11.1	875
1971-72	45.2	43.6	11.2	875
1972-73	44.9	43.7	11.4	874
1973-74	43.9	42.6	13.5	875
1974-75	44.8	43.7	11.5	881
1975-76	42.8	45.2	12.0	876
1976-77	42.6	44.7	12.7	854
1977-78	43.4	44.1	12.5	840
1978-79	43.4	43.3	13.3	799
1979-80	43.9	42.8	13.3	793
1980-81	43.6	44.2	12.2	802
1981-82	43.0	44.1	12.0	807
1982-83	44.0	45.3	10.7	778
1983-84	44.3	43.9	11.8	740

Source: Compiled from the estimates of area under crops prepared by the Bureau of Economics and Statistics, Government of Kerala.

The highest average yield was obtained from Palghat district. Of the 23 years considered here, in 20 years Palghat recorded the highest yield, in 2 years it came to the second place, and only once it dropped down to the fifth place. Among the three years when Palghat slipped from the highest yield level, Kottayam occupied that place in two years and Alleppey in one year. The lowest yield levels were recorded in Trichur and Ernakulam districts. The number of years when each district occupied the different rankings based on yield levels is given in Table 2. (1 indicates the highest yield/hectare and 7 the least).

Table 2: Ranking of the districts according to Yield levels during 1960-61 to 1982-83

District	Number of years when rank is						
	1	2	3	4	5	6	7
Trivandrum	-	4	2	5	9	3	-
Quilon	-	2	3	13	2	3	-
Alleppey	1	6	10	3	3	-	-
Kottayam	2	9	8	1	1	-	2
Ernakulam	-	-	-	-	4	11	8
Trichur	-	-	-	1	3	6	13
Palghat	20	2	-	-	1	-	-

A comparison of the district yield with the State average yield indicates that yield levels in Palghat were always above the State average and those in Trichur were always below the State average. The position of other districts indicated that in a majority of years, Trivandrum and Ernakulam had yield levels below the state average and for Kottayam, Alleppey and Quilon, they were above the state average. (Table 3)

Table 3: <u>Yield position of each district in relation to the State Average</u>

District	Number of years when district yield remained	
	Below State Average	Above State Average
Trivandrum	13	10
Quilon	9	14
Alleppey	7	16
Kottayam	4	19
Ernakulam	21	2
Trichur	23	-
Palghat	-	23

During 1983-84, the total production of rice in Kerala was 1,207,916 tonnes consisting of 520,458 tonnes in autumn, 520,622 tonnes in winter and 166,836 tonnes in summer. The shares of autumn, winter and summer production in the total production were 43.1%, 43.1% and 13.8% respectively. Between 1960-61 and 1983-84, the maximum production was 1,376,367 tonnes in 1972-73 and the minimum was 997,489 tonnes in 1965-66. The autumn production was maximum in 1973-74 and minimum in 1961-62; the winter production was maximum in 1972-73 and minimum in 1965-66; and the summer production was maximum in 1979-80 and minimum in 1961-62. The share of autumn production in the total production ranged between 38.9% in 1976-77 and 46.9% in 1960-61, winter production shares ranged between 39.1% in 1965-66 and 46.9 per cent in 1976-77, and summer production shares ranged between 8.6% in 1965-66 and 15.8% in 1979-80 (Table 4).

Table 4: Shares of Autumn, Winter and Summer Production in the total production

Year	Share of Production during			Total Production
	Autumn	Winter	Summer	
		(Per cent)		(1000 tonnes)
1960-61	46.9	41.9	11.2	1068
1961-62	41.9	46.0	12.1	1004
1962-63	45.3	44.1	10.6	1093
1963-64	45.3	44.2	10.5	1128
1964-65	44.1	45.4	10.5	1121
1965-66	52.3	39.1	8.6	997
1966-67	46.0	43.4	10.6	1084
1967-68	46.4	41.8	11.8	1124
1968-69	41.7	45.7	12.6	1251
1969-70	42.5	42.9	14.6	1226
1970-71	41.5	43.7	14.8	1298
1971-72	40.8	44.2	15.0	1352
1972-73	41.9	44.3	13.8	1376
1973-74	48.2	40.4	11.4	1257
1974-75	40.1	45.2	14.7	1334
1975-76	41.4	45.0	13.6	1329
1976-77	38.9	46.9	14.2	1254
1977-78	42.6	43.2	13.9	1295
1978-79	42.8	41.6	15.6	1273
1979-80	43.7	40.5	15.8	1300
1980-81	43.5	43.1	13.3	1272
1981-82	41.6	44.0	14.4	1339
1982-83	44.3	43.3	12.4	1306
1983-84	43.1	43.1	13.8	1208

4. GROWTH RATES

The growth rates of area, yield and production of rice during autumn, winter and summer together with those for all seasons for the two periods separately and for the combined period are summarised for the state and district levels.

4.1 <u>State Level</u>: The annual growth rate of area under paddy from 1960-61 to 1983-84 was only 0.15 per cent. While the annual growth rate of area was positive (1.14%) for the first period, it turned out to be negative (-1.50%) for the second period. Among the seasons, the highest growth rate for the first period was during summer, but for the second period the highest negative growth rate also occured during summer. Inspite of the negative growth rate of area during all three seasons for the second period, the annual growth rate of area for the combined period was negative only during autumn. During winter and summer the positive growth rates of area for the first period was large enough to overcome the negative growth rates for the second period.

The average annual growth rate of yield for the combined period was 1.01 per cent. The growth rate of yield for the second period (1.70%) was an improvement over the rate for the first period (0.92%). For both periods, the smallest growth rates of yield among the three seasons was obtained during winter. While the highest growth rate of yield for the first period was during summer, for the second period it was during autumn that the growth rate of yield was the highest. For the combined period also, the highest growth rate was obtained during autumn.

The annual growth rate of production for the combined period was 1.16%. The substantial drop in the growth rate of production for the second period over the first period had influenced the low rate for the combined period. The positive growth rates of both area and yield for the first period had contributed to a production growth rate above 2 per cent during this period. The increased growth rate of yield for the second period was offset by the negative growth rate of area.

While the growth rates of production were positive during all seasons and the combined seasons for the first period, they were negative during winter and summer for the second period. The negative growth rates of production during both these seasons were influenced by the dominant role played by the negative growth rates of area over the positive growth rates of yield. Though the growth rate of area was negative during second period autumn also, the positive growth rate of yield had offset the negative impact of area.

Table 5: Seasonal Growth Rates of Area, Yield and Production in Kerala

		Growth Rates During			
		Autumn	Winter	Summer	All Seasons
		(Per cent)			
Period I	Area	.10	1.79	2.72	1.14
	Yield	1.34	.23	1.71	.92
	Production	1.44	2.02	4.42	2.06
Period II	Area	-1.19	-1.58	-2.39	-1.50
	Yield	2.46	1.07	1.74	1.70
	Production	1.27	- .52	- .65	.21
Combined Period					
	Area	- .64	.63	1.59	.15
	Yield	1.41	.49	1.14	1.01
	Production	.78	1.11	2.73	1.16

4.2. Trivandrum District

Area: The overall growth rate of area under rice for the combined period was -.93% being the net outcome of a marginal growth rate (0.47%) for the first period and a large negative rate (-3.50%) for the second period. The growth rate for the combined period was negative during autumn and winter, but it turned out to be positive during summer on account of a high growth rate for the first period. During autumn, the growth rates of area were negative for both the first and second periods. Inspite of the negative growth rate of area during the first period autumn season, the positive growth rates during winter and summer could provide a positive growth rate of area for the combined seasons. However, the growth rates of area during all three seasons for the second period were negative.

The overall annual growth rate of yield for the combined period indicated a stagnant level with a growth rate of 0.09%. A major setback in yield levels occured during winter when the growth rates turned out to be negative for both periods separately and for the combined period.

The negative overall growth rate of area and the marginal growth rate of yield for the combined period had resulted in a negative growth rate of production (-.83%). While the growth rate of production for the first period remained positive during the three seasons, by the second period the negative growth rate of area had induced a negative growth rate of production for all seasons. Among the seasons, the negative growth rates during autumn and winter of the second period had influenced a negative growth rate of production for the combined period, but during summer, the first period positive growth rate of production prevailed over the second period negative growth rate.

Table 6: Seasonal Growth Rates of Area, Yield and production in Trivandrum District

		Growth Rates During			
		Autumn	Winter	Summer	All seasons
Period I					
	Area	-.09	.47	6.43	.47
	Yield	.65	-.11		.14
	Production	.56	.35	11.51	.61
Period II					
	Area	-2.39	-2.76	-23.89	-3.50
	Yield	1.01	-.89		.47
	Production	-1.39	-3.63	-18.81	-3.02
Combined period					
	Area	-1.12	-1.24	1.25	-.93
	Yield	.68	-.24	..	.09
	Production	.43	-1.47	1.27	-.83

4.3 Quilon District

The growth rates of area were positive during all seasons for the first period, during autumn for the second period, and during autumn and summer for the combined period. For the combined seasons, the growth rate remained positive for the first period, negative for the second period and again positive for the combined period. While the growth rates of area remained low for most seasons and periods, the performance during summer indicated a high positive growth rate for the first period and a high negative growth rate for the second period.

During autumn the growth rate of yield was 1.43% for the first period and 5.62% for the second period. However in winter, the growth rates for both periods were close to zero: and in summer, it was negative for the first period and positive for the second period. The growth rate of yield in the combined seasons for the second period (2.72%) was substantially higher than the corresponding rate (.42%) for the first period. Inspite of the negative growth rates of yield during winter and summer for the first period, the positive growth rate during autumn was sufficient to retain an overall positive growth rate for all seasons.

The overall annual growth rate of production for the combined period was about one per cent. Thanks to the relatively higher growth rate of yield for the second period, inspite of the negative growth rate of area, production growth rate in the second period was about double the rate for the first period. During autumn, the rate of growth of production was 2.01 per cent for the first period, 5.76 per cent for the second period and 2.88 per cent for the combined period. During winter, the first period growth rate of production was less than one per cent, and it became negative for the second and combined periods. While the growth rate of production during summer was 6.78% it turned out to be a high negative rate (-9.83%) for the second period.

4.4 Alleppey District

The average annual growth rate of area under paddy for the combined period was 0.36 per cent. While area increased at about 1.2% for the first period, the second period witnessed a negative growth rate of -1.43%. Changes in the area during winter season dominated the changes for both the first and second periods.

Table 7: Seasonal Growth Rates of Area, Yield and Production in Quilon District

		Growth Rates During			
		Autumn	Winter	Summer	All Seasons
		(Per cent)			
Period I					
	Area	.58	.72	8.71	.77
	Yield	1.43	-.01	-1.93	.42
	Production	2.01	.71	6.78	1.19
Period II					
	Area	.14	-.48	-14.04	-.52
	Yield	5.62	.37	3.33	2.72
	Production	5.76	-.12	- 9.83	2.22
Combined Period					
	Area	1.05	-.50	2.84	.24
	Yield	1.84	.25	-2.39	.76
	Production	2.88	-.25	0.57	.99

The annual growth rates of yield for the first and second periods individually and for the combined period were very small. During autumn, the growth rates of yield for both periods separately were less than one per cent. However, the positive growth rate of yield during second period winter had influenced an overall positive growth rate of yield for the combined period. The growth rate of yield during summer was more or less consistent for both sub periods and for the combined period.

The annual growth rate of production for the combined period was 1.81 per cent. A major influence in the annual growth rate for the combined period was exercised by the growth rate of 2.16 per cent for the first period against 0.68 per cent for the second period. It may be recalled that area under rice had a positive growth rate above one per cent for the first period and a higher negative growth rate for the second period. In spite of a slightly better growth rate of yield for the second period than the first period, the negative growth rate of area had influenced a poor growth rate of production for the second period.

The growth rate of production for the second period exceeded the rates for the first period during autumn and summer. In both these cases, the growth rates of area and yield for the second period had exceeded the corresponding rates for the first period. However, during winter, the growth rate of production for the second period was a negative rate of -6.42% against 1.62% for the first period. This negative growth rate of production was the outcome of a high negative growth rate of area. It is further observed that during autumn and winter for the combined period, the growth rate of area exceeded the growth rate of yield , and during summer, a negative growth rate of area was more or less compensated by a positive growth rate of production.

Table 8: Seasonal Growth Rates of Area, Yield and Production in Alleppey District

		Growth Rates During			
		Autumn	Winter	Summer	All Seasons
		(Per cent)			
Period I					
	Area	1.31	2.99	0.18	1.19
	Yield	.14	-1.53	2.30	0.97
	Production	1.52	1.62	2.50	2.16
Period II					
	Area	2.74	-7.87	2.72	-1.43
	Yield	.93	1.46	2.47	2.11
	Production	3.66	-6.42	5.18	.68
Combined Period					
	Area	2.28	2.48	-2.75	.36
	Yield	1.93	.62	2.45	1.45
	Production	4.21	3.16	..	1.81

4.5 Kottayam District

The annual growth rate of area under paddy for the combined period was negative as a result of the dominant negative growth rate for the second period over the positive growth rate for the first period. While the growth rate of area was positive during all the three seasons for the first period, it turned out to be close to zero during autumn and negative during winter and summer of the second period. This negative growth rate of area during winter and summer for the second period dominated over the positive growth rates for the first period to produce an overall negative growth rate during these two seasons for the combined period.

The annual growth rate of yield for the first period was 1.3%, but it increased to a high level of 4.39% for the second period. Among the seasons, the highest growth rate of yield was during summer for the first period and during autumn for the second period. The growth rates during all seasons in the second period were higher than the corresponding rates for the first period. The growth rate of yield during winter was the least among the three seasons for both periods and for the combined period.

The annual growth rate of production for the combined period was only 1.18%. Inspite of a moderate growth rate (2.76%) for the first period, the negative growth rate of -1.01% for the second period had a significant role in bringing down the overall growth rate. The highest growth rate was observed during winter for both periods individually and for the combined period. While area had a major influence on the autumn growth rate of production for the first period, it was yield that played the major role for the second period.

The growth rate of production remained positive during all seasons for the first period with a highest rate of 4.36% during autumn and a least rate of 1.32% during winter. However, for the second period the growth rate of production was positive only during autumn (6.42%) with negative rates of -1.77% during winter and -8.93% during summer. As pointed out earlier, the negative growth rates of area during these seasons accounted for the negative growth rates of production. The combined period had a positive growth rate of production(7.16%) during autumn, a negative rate (-1.79%) during winter and a zero growth rate during summer.

Table 9: Seasonal Growth Rates of Area, Yield and Production in Kottayam District

		Growth Rates During			
		Autumn	Winter	Summer	All Seasons
		(Per cent)			
Period I					
	Area	2.62	1.06	1.45	1.45
	Yield	1.74	.26	2.24	1.30
	Production	4.36	1.32	3.67	2.76
Period II					
	Area	0.04	-3.96	-14.19	-5.42
	Yield	6.38	2.20	5.26	4.39
	Production	6.42	-1.77	-8.93	-1.01
Combined Period					
	Area	4.75	-2.48	-2.64	- .61
	Yield	2.41	.69	2.65	1.79
	Production	7.16	-1.79	..	1.18

4.6 Ernakulam District

The annual growth rate of area for the combined period was 1.14% with 1.10% for the first period and -.04% for the second period It appears that Ernakulam district has made substantial improvements in area under paddy during summer. The overall growth rate of area under summer paddy in the district was 6.72% with a growth rate of 6.3% for the first period and 4.57% for the second period. However the growth performance of area under paddy during autumn and winter seasons was not encouraging. The autumn growth rate of area was -0.08% for the first period and -1.31% for the second period. The growth rate of winter area was 1.27% for the first period and -.30% for the second period. The growth rates during autumn and winter for the combined period also remained at a low level.

The overall growth rate of yield in the Ernakulam district was less than one per cent, mainly because of the very low growth rate for the first period. While the growth rate during first period autumn was slightly over one per cent, the negative growth rates during winter and summer had contributed towards the low annual rate. The growth rates of yield during all seasons of the second period ranged between 1.37% in summer and 1.85% in winter. The growth rates during autumn remained more or less the same for both the periods, but during both winter and summer, the negative growth rates for the first period had offset the positive growth rates for the second period to provide a very small growth rate for the combined period.

The overall annual growth rate of production for the combined period was about 2 per cent. The highest growth rate of production was during summer for both periods and the combined period: this was contributed mainly by increases in the cropped area. However during autumn, the growth rates of production were heavily influenced by the growth rates of area for both periods and for the combined period. The growth rates of production during winter remained at a low level for both periods, mainly on account of the negative growth rate of yield for the first period and a negative growth rate of area for the second period.

Table 10: Seasonal Growth Rates of Area, Yield and Production in Ernakulam District

	Growth Rates During			
	Autumn	Winter	Summer	All Seasons
	(Per cent)			
Period I				
Area	-.08	1.27	6.30	1.10
Yield	1.18	-.33	-.14	.18
Production	1.10	.95	6.18	1.48
Period II				
Area	-1.31	-.33	4.57	-.04
Yield	1.43	1.85	1.37	1.60
Production	.12	1.56	5.93	1.56
Combined Period				
Area	.28	.66	6.72	1.14
Yield	1.56	.22	.35	.81
Production	1.83	.88	7.04	2.01

4.7 Trichur District

The annual growth rate of area in Trichur district for the combined period was 0.48%: this being the resultant of growth rates of .75% for the first period and -1.81% for the second period. The growth rate of area during the first period summer was close to 5%, but the autumn and winter rates for the same period had been farily low. In the second period, the growth rate during summer was reduced to a nominal level, and the rates during autumn and winter had dropped to -1.62% and -2.76% respectively. The growth rates of area for the combined period was at a small positive level during autumn, negative for winter and close to 5% for summer. Thus, in Trichur district, there had been some increase in the area under summer paddy.

The annual growth rate of yield in the district had been consistently low: .35% for the combined period, .70% for the first period and 1.25% for the second period. The growth rate of yield remained below one per cent during all seasons for the first period, during summer of the second period, and during all seasons for the combined period. It was only during second period autumn that the growth rate of yield had reached close to 2.5%.

The annual growth rate of production for the combined period was also less than one per cent: 1.45% for the first period and -0.56% for the second period. The annual growth rate of production for the first period was influenced by a more or less similar growth rates of area and yield, but by the second period the negative growth rate of area exceeded the positive growth rate of yield. During autumn, the growth rates of production for the two periods and the combined period were somewhat similar. However, a comparitively large growth rate of yield during second period autumn had prevailed over the negative growth rate of area during this period. During winter the growth rate of production was less than one per cent for the first period, and it became negative for the second and the combined period.

on account of the predominant negative growth rate of area over the small positive growth rate of yield. The growth rate of production during the first period summer was somewhat high at 5.72%. Inspite of a decline in this rate to 1.22% for the second period, the summer growth rate for the combined period remained close to 5%. As pointed out earlier, the high rate of increase in summer area in the district was mainly responsible for this accelerated rate of growth inspite of a nominal increase in the yield level.

Table 11: Seasonal Growth Rates of Area, Yield and Production in Trichur District

		Growth Rates During			
		Autumn	Winter	Summer	All Seasons
		(Per cent)			
Period I					
	Area	.43	.21	4.91	.75
	Yield	.67	.49	.80	.70
	Production	1.10	.70	5.72	1.45
Period II					
	Area	-1.62	-2.76	0.50	-1.81
	Yield	2.48	1.08	.72	1.25
	Production	.86	-1.69	1.22	- .56
Combined Period					
	Area	.92	-.90	4.97	.48
	Yield	.14	.29	.64	.35
	Production	1.06	-.61	5.60	.83

.8 Palghat District

Palghat district had a negative average annual growth rate of ea for the combined period mainly on account of the negative growth te for the first period. During the first period, the growth rates of area remained negative during autumn and summer; and the positive growth rate during winter was not adequate to change this direction. The growth rates of area were positive for the second period autumn and winter, but turned out to be negative for the summer season. Inspite of the negative growth rates during summer for both periods individually the overall trend turned out to be positive. This apparent discripancy occurs on account of the sudden increase reported in 1975-76 probably from the changes in the estimation procedure.[14]

The annual growth rate of yield was about 1.5% which remained consistent for both periods and the combined period. The rate of growth for the combined period was above 2% during autumn, but dropped to about half per cent during winter. During summer, the first period had a relatively higher growth rate of 2.60% but it declined to 1.93% by the second period.

The annual growth rate of production for the combined period was .79%. The decline in the cropped area especially for the first period was responsible for the low growth rate of production. During autumn, the negative growth rate of area for the first period had partially offset the moderate growth rate of yield. However, the second period autumn growth rate of production crossed 3%, mainly on account of the increased growth rate of yield and a small positive growth rate of area. During winter, inspite of a growth rate of about

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14/ In Palghat, the summer area under paddy was 2,833 hectares in 1960-61 and it declined to 1943 hectares in 1974-75. However the 1975-76 area was reported as 7,976 hectares which remained around 4,000 hectares during the remaining period. Thus each period individually shows a decline, but overall a positive growth is indicated.

1%'in area, the marginal growth rates of yield had kept the growth rates of production at low levels. During summer the negative growth rates of area prevailed over the positive growth rates of yield to retain negative growth rates of production for both periods. However, as mentioned earlier, the growth rate for the combined period indicated a different tendency from the position obtained for individual periods.

Table 12: Seasonal Growth Rates of Area, Yield and Production in Palghat District

	Growth Rates During			
	Autumn	Winter	Summer	All Seasons
		(Per cent)		
Period I				
Area	-1.33	1.10	-4.68	-.38
Yield	2.34	.44	2.60	1.58
Production	1.00	1.55	-2.08	1.21
Period II				
Area	0.55	1.10	-8.96	.54
Yield	2.66	.05	1.93	1.51
Production	3.21	1.15	-7.03	2.06
Combined Period				
Area	-1.72	.72	1.27	-.62
Yield	2.10	.55	1.44	1.55
Production	.38	1.24	2.71	.79

5. COMPARATIVE PERFORMANCE

The growth rates of area, yield and production for each district can be synthesised to obtain an integrated view of the performance among the districts and among the seasons.

5.1 District Analysis (all seasons)

When the districts were classified on the basis of positive and negative growth rates for the two periods individually and for the combined period, in the first period all the seven districts had positive growth rates of production. However, in six districts the positive growth rates of production were associated with positive growth rates of both area and yield, and in the seventh district (Palghat) growth rate of production was positive inspite of a negative growth rate of area. In the second period, Palghat was the only district where area, yield and production had positive growth rates simultaneously. All the remaining districts had negative growth rates of area, but the positive growth rates of yield in Quilon, Alleppey and Ernakulam were sufficient to provide positive growth rates of production in these districts. However, the positive growth rates of yield in Trivandrum, Kottayam and Trichur were not sufficient to offset the negative growth rates of area, thereby prodution growth rates were negative in these three districts.

When the two periods were combined Quilon, Alleppey, Ernakulam and Trichur had positive growth rates of area, yield and prduction; Kottayam and Palghat had positive growth rates of yield and production but negative growth rate of area; and Trivandrum had negatie growth rates of area and production, but positive growth rate of yield.

The position in different districts is summarised in Table 13.

Table 13: Classification of District according to growth rates

Growth rates	Period I	Period II	Combined
+A, +Y, +P	TVM, QLN, ALP KOT, EKM, TCR (6)	PLGT (1)	QLN, ALP, EKM, TCR (4)
-A, +Y, +P	PLGT (1)	QLN, ALP, EKM (3)	KOT, PLGT (2)
-A, +Y, -P		TVM, KOT, TCR (3)	TVM (1)

Note: + indicates positive growth rates and - indicated negative growth rates, A = area, Y = yield; P = production.

5.2 Season Analysis

The growth rates during autumn, winter and summer seasons indicated a number of interesting tendencies.

In the first period the growth rate of area was maximum during summer, but for the second period, the maximum negative growth rate of area was also observed during summer. The maximum growth rate of yield for the first period was observed during summer, but by the second period, growth rate of yield during summer had fallen behind the autumn growth rate of yield. Thus both area and yield for the first period had the highest growth rates during summer resulting in the highest growth rate of production, but because of the reversal in both area and yield rates for the second period production growth rate was minimum during summer.

While the growth rates of production were positive for the first period during all seasons and for the combined seasons, winter and summer seasons of the second period recorded negative growth rates of production - an outcome of the dominant role played by the negative growth rates of area over the positive growth rates of yield. Though the second period growth rate of area was negative during autumn season also, the positive growth rate of yield during this period had offset the negative impact of area to provide a positive growth rate of output.[15/]

In the first period, output growth rates were positive for all seasons and districts except for Palghat during summer. The negative growth rate of output in Palghat was influenced by the dominant role played by the negative growth rate of area over the positive growth rate of yield.

The growth rate of production for the second period were negative during winter in Trivandrum, Quilon, Alleppey, Kottayam and Trichur. The negative rate of growth of output in Trivandrum district was influenced by the negative growth rates of both area and yield, and in all other districts the negative output growth was the outcome of dominant negative growth rates of area over positive growth rates of yield.

During summer of the second period, output growth rates were negative in Trivandrum, Quilon, Kottayam and Palghat; all because of the dominant negative growth rates of area over the positive growth rates of yield. Thus the observed second period negative growth rates of output levels during winter and summer are mainly influenced by the negative growth rates of area (Table 14).

15/ The relevant growth rates are available in Table 5.

Table 14

Classification of districts according to growth rates of area, yield and production (season wise)

	Period I			Period II		
	Autumn	Winter	Summer	Autumn	Winter	Summer
+A, +Y	QLN	-	TVM	QLN	-	
	ALP	-	ALP	ALP		ALP
	KOT	KOT	KOT	KOT		EKM
	TCR	TCR	TCR	PLGT	PLGT	TCR
		PLGT				
	(4)	(3)	(4)	(4)	(1)	(3)
+A, -Y		TVM				
		QLN	QLN			
		ALP				
		EKM	EKM			
		(4)	(2)			
-A, +Y	TVM			TVM(P-)	ALP(P-)	TVM(P-)
	EKM				QLN(P-)	QLN(P-)
	PLGT		PLGT(P-)		KOT(P-)	KOT(P-)
					EKM	
				EKM	TCR(P-)	PLGT(P-)
				TCR		
	(3)		(1)	(3)	(5)	(4)
-A, -Y	-	-	-	-	TVM(P-1)	-
					(1)	

Note: (P-) Corresponds to negative growth rate of production. In all other cases, output growth rate is positive. + indicates positive growth rates, - indicates negative growth rates. A for area and Y for yield.

The canges in the variability[16] of area between the first and second periods indicate that autumn variability increased in Kottayam and decreased in all other districts. During winter, variability of area increased in Trivandrum, Alleppey and Trichur, but decreased in the other districts; and during summer increased variability of area was recorded in Trivandrum, Quilon, Alleppey, Kottayam and Ernakulam.

In general, the variability of yield levels decreased in most areas. During autumn, yield variability had increased in Trichur but it had decreased in four districts and remained stable in the other two districts. During winter, variability of yield increased only in Alleppey, and during summer Quilon was the only district which recorded increased variability of yield.

The variability of output levels increased during autumn in Kottayam; during winter in Alleppey and during summer in Trivandrum, Quilon, and Alleppey. The overall annual variability of area increased in Trivandrum, Alleppey, and Kottayam; variability of yield increased in Palghat, and variability of production did not show an increase in any district. Thus along with stagnation in production, the variability in output levels declined over time. (Table 15).

6. GROWTH AND STABILITY

It has been pointed out that the measures adopted for accelerated growth of agricultural production in India have often resulted

16/ Variability was measured using the coefficient of variation obtained from the standard error of the estimated function expressed as a percentage of the mean of the estimated trend values.

Table 15

Classification of Districts according to changes in Coefficient of variation of area, yield and production*

Seasons	Variability in area		Variability in yield		Variability in production	
	Increased	Decreased	Increased	Decreased	Increased	Decreased
Autumn	KOT	QLN, ALP EKM TCR, PLGT	TCR	TVM ALP, KOT EKM	KOT	TVM EKM TCR, ALP PLGT
Winter	TVM ALP	QLN EKM PLGT	ALP	TVM, QLN KOT, EKM TCR, PLGT	ALP	TVM QLN, EKM TCR PLGT
Summer	TVM QLN ALP KOT EKM	TCR	QLN	ALP, KOT, EKM TCR, PLGT	TVM QLN ALP	KOT TCR PLGT
All Seasons	TVM ALP KOT	EKM TCR PLGT	PLGT	QLN ALP KOT EKM TCR		TVM ALP KOT EKM TCR

* In the districts left out in each season, there was no change in the coefficient of variation.

in increasing annual fluctuations in production, especially after the introduction of high yielding varieties.[17/] Since increased fluctuations in output levels lead to a number of problems in food management operations, often measures are initiated to reduce variability in output levels along with achieving sustained levels of growth. Here an attempt is made to analyse the performance of rice in Kerala in relation to growth and stability.

The growth rates of area under paddy declined during the second period over the first period for all the three seasons individually and for the combined seasons. However, between the two periods, annual fluctuations in area declined during autumn and winter; and it remained stable during summer and the combined seasons. Some of the important factors responsible for acreage adjustments include changes in the physical conditions (especially irrigation facilities), weather conditions and relative price changes. A change induced by weather condition is more of a short term nature than the changes induced by other factors, and therefore weather induced change in cropping pattern have a tendency to increase the fluctuations in area. The fact that growth rates of area remained negative during all seasons and that the fluctuations remained either at stable levels or decreased over the two periods indicates that the reduction in area was the result of conscious decisions made at the farm level in favour of substituting other crops for paddy. This can be either because land diverted from paddy is brought under long duration crops (perennial crops) or because disadvantageous relative price situation prevailed over a long period.

17/ See S.R. Sen (1967) and CHH Rao (1975)

While area indicated negative growth rates for the second period, the growth rates of yield for the second period were consistently above the first period's rates for all the three seasons. However, the fluctuations of yield have declined during winter and summer, and remained stable during autumn indicating an overall reduction in variability of yield during the second period. This is somewhat contradictory to the experience in the early phase of high yielding varieties when the yield increses associated with the new varieties induced higher levels of fluctuations over time. At

the same time the reduced level of fluctuations of yield is consistent with the reduced level of fluctuations of area indicating that the land retained under paddy cultivation was suitable for this purpose and that there was no major inbuilt technology bias towards inducing higher levels of fluctuations. Even if there existed some technology bias towards increased level of fluctuations, such tendencies might have been overcome either by physical conditions (especially land quality) or by possible measures adopted to safeguard crops from the vagaries of nature.

In general, a situation of improved growth rate of yield associated with reduced variations would be most desirable. However, the performance of rice in Kerala during the second period do not provide such an encouraging outlook. The increased growth rate of yield for the second period was only a mild recovery from the near stagnant growth rate for the first period. The compound growth rates of yield (1.7% for all seasons, 2.46% during autumn, 1.07% during winter and 1.74% during summer) were well below the rates achieved in many other parts of India. Further, the increase in growth rate of yield was not sufficient to offset the decline in the growth rate of area, so that the outcome was a decline in the growth rate of output.

As indicated before, the growth rates of output for the second period were below the rates for the first period during all the three seasons. Along with the fall in output levels, there had been a declin in the fluctuations of output levels. Since it is normal to expect increased fluctuations associated with increased output levels, it is consistent to expect reductions in variability associated with reduced growth rates. In Kerala, reductions in the fluctuations of both area and yield of rice have contributed towards a reduced level of variability in output of rice.

The observed behaviour of changes in growth rates and fluctuation for the state was not uniformly consistent for all the districts: the emerging tendencies among the districts indicated a very scattered pattern. For example, while there was no instance of increased fluctuations at the state level in area, yield and output for the combined seasons, the fluctuations of area for the combined seasons increased in Trivandrum, Alleppey and Kottayam. Increased fluctuations of area for the second period was observed during autumn in Kottayam, during winter in Trivandrum, Alleppey and Trichur; and during summer in Alleppey. Fluctuations of yield levels increased in Trichur (autumn), Alleppey (winter), and Quilon (summer); and fluctuations of output levels increased in Kottayam (autumn), Alleppey (winter), and Alleppey, Trivandrum and Quilon (summer). Thus, in general fluctuations of area, Changes in Growth Rates and Coefficient of Variations

Season	Increase(+) or decrease (-) growth rate	Coefficient of Variations for								
		Area			Yield			Output		
		Increase	Decrease	Stable	Increase	Decrease	Stable	Increase	Decrease	Sta
Autumn	+		ALP PLGT		TCR	TVM, ALP KOT, EKM	QLN PLGT KERALA	KOT	ALP PLGT	QLN
	-	KOT	QLN,EKM,TVM TCR KERALA						TVM,EKM TCR KERALA	
Winter	+				ALP	QLN, KOT EKM, TCR KERALA			EKM	
	-	TVM ALP TCR	QLN EKM PLGT KERALA	KOT		TVM PLGT		ALP	TVM, QLN KOT, TCR PLGT KERALA	
Summer	+	ALP			QLN	ALP, KOT EKM KERALA		ALP		
	-	TVM,QLN KOT,EKM	TCR PLGT	KERALA		TCR PLGT		TVM QLN	KOT,TCR PLGT KERALA	EKM
All Seasons	+		PLGT			QLN,ALP KOT,EKM TCR KERALA			EKM	QLN PLGT
	-	TVM ALP,KOT	EKM TCR	QLN KERALA	PLGT				TVM,ALP KOT,TCR KERALA	

TVM = Trivandrum ALP = Alleppey EKM = Ernakulam PLGT = Palghat QLN= Quilon KOT = Kottayam TCR = Tricl yield and output indicated an increasing tendency in some of the Southern districts of Kerala. However the opposite tendency in the northern districts and some of the Southern districts (different districts for different seasons) had a dominant role so that for the state as a whole, the fluctuations of area, yield and output declined or remained stagnant.

7. SOURCES OF GROWTH

An additive decomposition model was used to identify the contributions of area, yield and interactions in explaining the changes in production over the period.[18/] The changes in production were analysed for each season and for the annual data. Further, the changes in the first and second periods were separately considered along with the combined period.

7.1 Autumn: For the first period, 90% of the changes in autumn rice production levels in the state were accounted by yield, 8% by area and 2% by interaction between area and yield.[19/] However, for the second period yield had a positive contribution of 205%, the area effect was - 93% and the rest was accounted by the interaction effect. When the two periods are pooled together (the combined period), the contribution of yield was 170% and the contribution of area was - 53%. For the combined period yield effect was positive in all the districts, but the area effect was positive only in Quilon, Alleppey, Kottayam, Ernakulam and Trichur. Inspite of the positive contribution of area in these five

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18/ See Minhas and Vaidyanathan (1965)

19/ Three year average levels for the base year and final year were used.

districts, the negative contributions of area in Trivandrum and Palghat influenced the negative overall contribution of area in the State. The contributions of yield were positive in all the districts for the first and second periods. However, the contribution of area for the first period remained negative in Trivandrum and Palghat, and for the second period it was negative in Trivandrum, Kottayam, Ernakulam and Trichur.

7.2 <u>Winter</u>: A major share of increase in production of winter paddy for the first period was accounted by the changes in area. For the second period, the contribution of area was a large negative value and it was only partially offset by the increase in the contribution of yield. However for the combined period, area changes contributed to 53% of the changes in production and the contribution of yield was 42%.

For the first period, the contribution of area was positive in all the districts and the contribution of yield was positive only in Trichur and Palghat. By the second period the position was reversed so that the contribution of area became negative in all districts and the contribution of yield was positive in all districts except Trivandrum. For the combined period, the contribution of area was positive in Alleppey, Ernakulam and Palghat; and the contribution of yield was positive in all districts except Trivandrum and Quilon.

7.3 <u>Summer</u>: For the state as a whole, for the first period 68% of the changes in summer production was accounted by area and 24% by yield. This was reversed for the second period to the extent that the contribution of area was a negative rate of - 377% with a contribution of 309% from yield. When the two periods were combined 55% of the changes in summer production was accounted by area changes and 36% by yield changes.

Among the districts, for the first period the contribution of area was positive in all districts except Palghat; and the contribution of yield was positive in all districts except Ernakulam. For the second period, the contribution of area was positive in Alleppey, Ernakulam, and Trichur; and the contribution of yield was positive in all districts. For the combined period, the contribution of area was positive in Quilon, Ernakulam, Trichur and Palghat; and the contributio of yield was positive in all districts except Quilon.

7.4 <u>All seasons</u>: The contribution of area accounted for 53% of the production changes for the first period and the contribution of yield was 41%. However for the second period the position was reversed so that area accounted for a large negative share (-702%) as against a larger positive share (864%) of yield. For the combined period, the share of yield dominated to the extent that 89% of the change in output was accounted by yield and only 9% was explained by area.

For the first period, the contribution of area remained positive in all districts except Palghat, and the contribution of yield was positive in all districts except Trivandrum and Ernakulam. For the second period, the contribution of area was positive only in Ernakulam and Palghat, but the contribution of yield was positive in all district When the two periods are combined, the contribution of area remained positive in Quilon, Alleppey, Ernakulam and Trichur; and the contribution of yield remained positive in all districts except Trivandrum.

Table 17: Contribution of area and yield in production change

(Per cent)

	Period 1		Period 2		Combined	
	Area	Yield	Area	Yield	Area	Yield
A. Autumn						
Trivandrum	-6	107	-186	97	-154	67
Quilon	37	58	3	96	30	56
Alleppey	91	7	61	34	52	32
Kottayam	57	32	-14	119	50	21
Ernakulam	-8	110	-860	802	24	70
Trichur	28	30	-113	231	76	20
Palghat	-78	209	20	78	-135	310
Kerala	8	90	-93	205	-53	170
B. Winter						
Trivandrum	244	-136	-79	-24	-79	-26
Quilon	175	-69	-281	388	-93	-7
Alleppey	225	-92	-104	6	71	19
Kottayam	59	-155	-224	154	-122	34
Ernakulam	185	-77	-13	144	83	15
Trichur	18	80	-170	81	-301	237
Palghat	81	17	89	10	62	32
Kerala	89	7	-323	242	53	42
C. Summer						
Trivandrum	--	-	-121	64	-	--
Quilon	170	-27	-121	44	342	-142
Alleppey	16	82	46	49	-479	602
Kottayam	37	56	-140	85	-217	245
Ernakulam	115	-8	80	16	91	3
Trichur	95	13	69	30	87	6
Palghat	-144	73	-133	48	42	45
Kerala	68	24	-377	309	55	36
D. All Seasons						
Trivandrum	128	-26	-123	27	-96	-5
Quilon	85	14	-14	116	31	65
Alleppey	80	17	-1323	1542	20	75
Kottayam	61	35	-334	318	-120	260
Ernakulam	10[illegible]	-1	8	92	53	29
Trichur	48	48	-481	416	47	48
Palghat	-27	134	35	62	-28	137
Kerala	53	41	-702	886	9	89

The shares of area and yield in the changes in production for the first, second and combined periods in each season are available in Table 17. The portion unexplained by these two factors is accounted by the interaction term.

The contributions of area, yield and their interaction towards changes in production can be further analysed to isolate the dominant factor influencing production changes in each season. During autumn, area was the dominant factor in Alleppey and Kottayam districts for the first period; in Trivandrum, Alleppey, and Ernakulam for the second period; and in Trivandrum, Alleppey, Kottayam, Ernakulam and Trichur for the combined period. During winter, area was the dominant factor in Trivandrum, Quilon, Alleppey, Ernakulam and Palghat for the first period; in all districts except Quilon and Ernakulam for the second period; and in all districts for the combined period. During summer, area dominated in all districts except Alleppey and Kottayam for the first period; Alleppey for the second period; and Alleppey, Kottayam and Palghat for the combined period. When annual data was analysed, area turned out to be the dominant factor in all districts except Palghat for the first period; in Trivandrum, Kottayam and Trichur for the second period; and in Trivandrum and Ernakulam for the combined periods.

It can be observed from the changes that at the state level, yield was the dominant factor influencing production changes during autumn for both periods separately and for the combined period. However, during winter and summer, area changes dominated the production change for both periods and the combined period. For the annual data, at the state elevel area dominated for the first period, yield dominated for the second period and the overall period. Thus, for the first period, the dominance of yield during autumn was nullified by the dominance during winter and summer so that area emerged as the overall dominant factor for the annual data. For the second period, the dominance of yield during autumn had offset the dominance of area during winter and summer to emerge as the dominant force influencing annual changes in production.

Another interesting aspect of the changes relate to the decline in production levels. The output levels in the terminal period were below the corresponding levels in the base period for the following cases:

Autumn: Period 2: Trivandrum and Ernakulam
Combined period: Trivandrum

Winter: Period 1: Kottayam
Period 2: Trivandrum, Alleppey, Kottayam, Trichur
Combined Period: Trivandrum, Quilon, Kottayam, Trichur

Summer: Period 1: Palghat
Period 2: Trivandrum, Quilon, Kottayam and Palghat
Combined period: Kottayam.

Annual: Period 2: Trivandrum, Kottayam, Trichur
Combined period: Trivandrum

In all these cases except for Kottayam (winter, period 1 and summer, combined period), the dominant factor influencing production changes was area. Thus changes in area was the underlying factor responsible for decline in production levels.

	Period I		Period II		Combined	
	Area	Yield	Area	Yield	Area	Yield
Autumn	ALP KOT	TVM QLN EKM TCR PLGT (State)	TVM(-) ALP EKM	QLN KOT TCR PLGT (State)	TVM(-) ALP KOT TCR	QLN EKM PLGT (State)
Winter	TVM QLN ALP EKM PLGT (State)	KOT(-) TCR	TVM(-) ALP(-) KOT(-) TCR(-) PLGT (State)	QLN EKM	TVM(-) QLN(-) ALP KOT(-) EKM TCR PLGT (State)	
Summer	QLN EKM TCR PLGT(-) (State)	ALP KKOT	TVM(-) QLN(-) KOT(-) EKM TCR PLGT(-) (State)	ALP	QLN EKM TCR (State)	ALP KOT(-) PLGT
Annual	TVM QLN ALP KOT EKM (State) (Trichur area and yield effect same)	PLGT	TVM(-) KOT(-) TCR(-)	QLN ALP EKM PLGT (State)	TVM(-) EKM	QLN ALP KOT TCR PLGT (State)

(-) indicates decline in production

7.5 Annual Changes

The analysis of the sources of growth based on changes over a period can be considered as trends emerging over a medium term or a long term horizon depending on the duration of the period. At the same time, analysis of annual changes in area, yield and production, all of which can be considered as short term changes, is also important to understand the change pattern. It can be visualised that short term changes (obtained from analysing annual changes) could be either consistent with medium term changes (obtained from changes over the interval) or that the short term changes do not necessarily add up to the medium term changes. The divergence between short term and medium term changes could also imply that a factor which was responsible for most of the short term changes had relatively smaller influence over the interval as compared to another factor emerging as the dominant force.

7.5.1 Period 1

For the first period consisting of 14 annual changes, during autumn, production increased in 10 years and declined in 4 years. In both these situations change in yield was the major factor responsible for production changes. This is also consistent with the result obtained for the whole period using terminal values. During winter yield was the dominant factor for 7 out of 10 cases of production increase and for all the 4 cases of production decline. It may be recalled that when changes in production based on end values were considered area turned out to be the dominant factor for the winter season. While annual changes in yield dominated annual changes in production in most years, in the analysis based on end periods, it was area that emerged as the dominant factor. The results for the summer and for the combined seasons also indicated a pattern similar to the winter season.

Among the districts while yield was the dominant factor, Quilon was the only exception where in a majority of years, annual production changes were dominated by area changes during the summer season.

7.5.2 Period 2

For the second period, of the seven annual changes, autumn had four cases of production increase and three cases of production decline. In all cases of production increase and in two cases of decline yield was the dominant factor. Here again the dominant role of yield is consistent with the results based on the changes obtained for the interval. During winter yield dominated only one of the two cases of production increase and one of the five cases of decline in production. Thus during winter annual changes in area was the dominant factor influencing production changes, which was again consistent with the result based on the performance for the interval. During summer yield dominated all the four cases of production increases and two out of three cases of decline in production. However, it may be recalled that when the changes during the interval was considered, area was the dominant factor explaining production changes. The dominance of yield in the combined seasons was also consistent with the changes over the interval. Among the districts, dominance of area was noticed for production decline in Trivandrum (summer), Alleppey (winter and summer) Kottayam (winter and summer), Trichur (summer) and Palghat (summer).

7.5.3 Combined Period

For the combined period, yield was the dominant factor for all the 15 cases of production increases during autumn, 8 out of 12 increases during winter, 11 out of 13 increases during summer and 10 out of 12 increases in the combined seasons. As far as production decline was considered, yield was the dominant factor in 6 out 7 cases during autumn, 6 out of 10 cases during winter, 8 out of 9 cases during summer, and 5 out of 10 cases in the combined seasons. Here it may be recalled that when the changes over the interval was considered, yield dominated only during autumn and in the combined seasons, while area dominated during winter and summer. Among the districts, the dominance of area in annual production changes for the combined period was noticed only for Trivandrum (summer, decline) and Quilon (summer, increases).

Thus it is apparent that annual changes in area under paddy had a dominant role in production changes in a fewer number of years than the annual changes in yield. However, area changes over an interval had emerged as the dominant factor in winter and summer for both the first and second periods. The number of years when yield dominated annual changes in production according to the districts and seasons is available from Table 19.

8. FACTORS INFLUENCING PERFORMANCE

The contributions of area and yield in explaining changes in production of rice during different periods indicated differential pattern across the districts and seasons over the years. Here an

		Period I				Period II				Combined			
		A 2/	W	S	All	A	W	S	All	A	W	S	All
Trivandrum 1/	(a)	6/6	7/7	4/4	4/7	2/2	2/3	2/3	2/2	9/9	9/10	6/8	6/9
	(b)	8/8	7/7	2/2	7/7	3/5	2/4	0/4	3/5	11/13	9/12	2/6	10/13
Quilon	(a)	5/6	6/6	2/7	5/6	4/4	3/3	2/3	5/5	9/11	9/9	4/11	10/12
	(b)	7/8	7/8	6/7	7/8	3/3	2/4	2/4	1/2	10/11	9/13	8/11	8/10
Alleppcy	(a)	6/8	9/10	9/9	6/7	1/3	2/4	2/4	2/3	8/12	11/15	11/13	8/10
	(b)	5/6	4/4	5/5	5/7	2/4	1/3	1/3	3/4	7/10	5/7	6/9	9/12
Kottayam	(a)	6/8	5/6	7/7	5/6	3/4	1/4	1/1	1/3	8/13	6/10	8/8	6/9
	(b)	4/6	7/8	6/7	7/8	1/3	0/3	1/6	0/4	5/9	7/12	7/14	8/13
Ernakulam	(a)	5/6	4/6	6/9	5/8	3/3	5/5	3/4	5/5	8/10	9/11	9/13	10/14
	(b)	7/8	7/8	5/5	6/6	2/4	1/2	2/3	2/2	9/12	9/11	8/9	8/8
Trichur	(a)	6/7	9/9	7/8	8/8	2/3	2/2	1/2	3/4	8/11	11/11	11/11	11/13
	(b)	5/7	5/5	5/6	5/6	2/4	3/5	2/5	2/3	7/11	9/11	7/11	7/9
Palghat	(a)	10/10	6/8	5/7	6/8	4/4	2/3	2/3	3/3	14/14	8/11	7/11	9/11
	(b)	3/4	5/6	6/7	5/6	3/3	3/4	0/4	3/4	6/8	9/11	6/11	8/11
Kerala	(a)	10/10	7/10	7/9	7/9	4/4	1/2	4/4	3/3	15/15	8/12	11/13	10/12
	(b)	4/4	4/4	5/5	3/5	2/3	1/5	2/3	2/4	6/7	6/10	8/9	5/10

A: Autumn, W: Winter, S: Summer

1/ (a) Corresponds to years when production increased and (b) corresponds to years when production declined.

2/ The first number in each cell corresponds to the years when yield dominated and the second number corresponds to the total number of cases. Thus 4/7 in a row marked (a) means that out of 7 cases when production increased, yield was the dominant factor in 4 cases and in the remaining three cases, area was the dominant factor.

attempt is made to analyse the factors responsible for changes in a and yield with particular reference to the role of relative prices a acreage adjustments, and the role of high yielding varieties (HYV) • irrigation in explaining yield levels. Since yield data for HYV non-HYV according to irrigation facilities were available only the second period, the analysis was confined to this period

Acreage adjustments

The annual growth rate of area under paddy for the combined iod was only a marginal rate(.15%). Farm level decisions on acreage ocations under different crops are often considered to be influenced changes in relative prices of different crops. Along with changes yield and cost, price changes influence the relative profitability different crop enterprises and this shift in profitability influences age adjustments through increased total cropped area or shifts in existing cropping pattern.

Though acreage adjustments of paddy can be influenced by the ges in the relative profitability with respect to a number of crops as sugarcane, banana, vegetables and coconut, it is the conversion addy land to coconut that is often mentioned in the Kerala context. iew of this and considering the data availability, the present ysis is confined to the adjustments of paddy area in response to ges in paddy prices relative to coconut prices.[20]

Acreage adjustments can be analysed either in terms of changes area in response to changes in relative prices or using actual area actual prices. In the first case, changes in paddy area over the

An analysis of agricultural price movements in Kerala indicated that the increase in wholesale price of nonfood crops was much higher than the increase in wholesale price for food frops. Among food crops, the lowest increase was for cereals. (See George P.S., 1982) years (Δ_n) is the dependent variable and the movements in price ratio between coconut and paddy (P_c / P_p) is the independent variable. However, it is difficult to obtain an estimate of the elasticity of paddy area with respect to paddy prices or coconut prices. Since the second formulation provides these elasticity measures, it was decided to analyse the movements in actual area under paddy in response to changes in price levels of paddy and coconut. In addition to prices, acreage adjustments are also influenced by other factors such as technology, and input prices. In the absence of relevant annual data for such variables, a time trend was included in the specification. Thus, the economic model specified for the analysis was

$$A_p = f(P_p, P_c, t) \text{ where}$$

A_p = area under paddy

P_p = farm level price of paddy

P_c = farm level price of coconut

and t = time trend.

As usual different functional forms were tried out with and without introducing the time variable. The best estimate based on the goodness of fit and significance of the coefficients was obtained from semi-log specification with time trend included as a variable. The estimated equation had the following coefficients and t values.[21/]

Variable	Coefficient	t value
Paddy price (P_p)	.0006	2.59
Coconut price (P_c)	-.0002	3.13
Time (t)	.0101	2.44

21/ When lagged prices were used, the results turned out to be quite similar. Since this period witnessed an increasing trend of coconut prices as against the fluctuating paddy prices, substitution was assumed to be in a single direction (i.e. from paddy to coconut)

All the coefficients had signs consistent with apriori expectations and statistically significant t values. Further, the F value for the total equation was also significant. The elasticities at the mean values indicated that for one per cent increase in paddy price, paddy area increased by 0.0702 per cent and for one per cent increase in coconut price, paddy area decreased by 0.1257 per cent. Thus paddy area was inelastic with respect to both paddy price and coconut price, though both had statistically significant influence on area.

Conversion of paddy area to coconut involves a permanent shift in acropping pattern. However, it is likely that farmers may not shift from a seasonal crop to a perennial crop based on relative price change in the short run. When prices and wages turn out to be unfavourable, the first reaction may be to keep land fallow for the current year and to watch the situation before a permanent shift is contemplated. In such situations, the current fallow might be a good indicator of the farmers' response. The area under current fallow in 1969-70 was 22,866 hectares and it increased to 44,487 hectares in 1981-82.

While the current fallow (F_t) was related with lagged paddy price (P_{t-1}) and wage rate (W_{t-1}), it was observed that wage rate had a very significant influence on current fallow. The estimated euqation was

$$F_t = 5.197 \underset{(1.23)}{-3.811} P_{t-1} + \underset{(7.46)}{4.6325^{***}} W_{t-1}; \quad R^2 = .86$$

Since paddy is grown during different seasons, it is possible that annual lags can be modified by seasonal lags. Thus, based on the first seasons experience the farmers might change their decision to

*** Significant at 1%

keep land fallow in the second season, and therefore the area under fallow could respond to prices and wages in the same period. The relationship among current fallow (F_t), paddy price (P_t) and wage rate (W_t), indicated that both P_t and W_t had a significant influence on current fallow. The estimated equations indicated that current fallow declined with increased paddy price and it increased with increased wage rate.

$$F_t = 13.019 \underset{(2.71)}{-8.9427^{*}} P_t + \underset{(7.26)}{4.2582^{***}} W_t; \; R^2 = .84$$

As indicated earlier, changes in relative prices constitute only a partial explanation for acreage adjustments. Following Nerlove lagged expectation models,[22/] a number of studies have explained current year's acreage adjustments through lagged responses to previous years actual experience on the farm. Since profitability of a particular crop enterprise depends on yield price and cost of production, farmer base their current expectation on their previous experience with these factors. Here it is proposed to analyse the acreage response of paddy area using the following specifications:

$$A_t = f\,(Y_{t-1},\ P_{t-1},\ C_{t-1}) \text{ where}$$

A_t = Area under paddy during period t

Y_{t-1} = Yield in t-1

P_{t-1} = Price in t-1

C_{t-1} = a measure of cost of production in t-1

Wage rate (W_t) and fertiliser price (N_t) were used as two indicator of cost of production. The estimated equation had the following coefficients:

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* Significant at 5% *** Significant at 1%

22/ Nerlove (1958)

Dependent variable	Equation 1	Equation 2 a/
Lagged yield (Y_{t-1})	.233 (1.82)	-.053 (1.32)
Lagged price (P_{t-1})	89.459** (3.81)	28.815 (.93)
Lagged wage rate (W_{t-1})	-17.131* (2.67)	-28.245* (2.41)
Lagged Fertiliser price (N_{t-1})		17.812 (.75)

From the first equation it is apparent that both lagged price and lagged wage rate turned out to be significant in explaining the area under paddy. Both the variables had signs consistent with *apriori* expactations indicating that paddy area increased with increased paddy price and it declined with increased wage rate. When fertiliser price was also introduced to represent the cost of production in the second equation, it did not improve the results.

8.2 High Yielding Varieties

8.2.1 HYV area

During 1982-83, 25.2 per cent of the cropped area under paddy during all seasons was covered under HYV. Among the districts, Trivandrum had the least coverage (5.3%) and the highest was in Kottayam (54.1%). The coverage of area under HYV during 1982-83 autumn, winter, and summer were 33.1%, 14.7% and 37.6% respectively.

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* significant at 5% ** significant at 1%

a/ The non-significance of the lagged price (P_{t-1}) in this equation seems to be due to the high multi-collinearity with the lagged fertiliser price (N_{t-1}).

Between 1975/76 and 1982/83 the coverage of area under HYV during autumn declined in Trivendrum (from 14.6% to 7.0%), and Alleppey (from 42.0% to 29.2%); and it increased in all other districts, the highest increase being in Quilon (from 18.5% to 60.8%). The coverage of HYV area during winter declined in Trivandrum (from 11.7% to 1.7%) Quilon (7.4% to 6.6%), Kottayam (61.1% to 50.8%), Ernakulam (7.8% to 4.09%) and Trichur (23.3% to 7.7%). During summer Alleppey, Kottayam and Trichur had good coverage of HYV. However, in Alleppey where about 85% of summer area was under HYV during 1978-79, the proportion has declined to 36% by 1982/83. A similar drop in the proportion of summer area under HYV occurred in Kottayam (from 94.5% in 1978-79 to 52.1% in 1982-83).

The growth rates of area under HYV and non HYV paddy indicated that during the second period, there had been an overall decline in area under both HYV and non HYV. While area under HYV declined by 1.57% annually, area under non-HYV declined by [illegible]. It may be recalled that the annual growth rate of total area under paddy declin during all the three seasons, the growth rates being -1.19% during autumn, -1.58% during winter and -2.39% during summer. However, the observed negative growth rates of area during the three seasons were not uniformly distributed between HYV and non HYV. During autumn HYV area had a negative growth rate of -2.73%. Thus, during autumn, while area under paddy declined, simultaneously there had been a shift from non-HYV to HYV. During winter, both HYV and non HYV area declined, but the decline was more pronounced in the case of non-HYV. During summer, while HYV area declined at an annual rate of -10.0%, non HYV area increased at an annual rate of 6.6[illegible]% which indicates that while the overall area under paddy declined during summer, simultaneously there was a shift from HYV area to non HYV. It is often argued that profitability of HYV depends on the acceptance of a package of practices whose viability depends on assured rainfall or irrigation facilities. Since autumn paddy is largely dependent on monsoon, it appears that farmers found it profitable to shift from traditional varieties to HYV. However, their experience with HYV during summer might have been discouraging and therefore they might have shifted back to non HYV.[23] Considering some of the evidence available in the next section it could be visualised that the change might be due to unreliable irrigation facilities.

The positive growth rate of HYV during autumn was influenced by the increase in area under HYV in Quilon (24%), Alleppey(3%) and Palghat (7%). Autumn HYV area in the other districts had a negative growth rate and non-HYV area had positive growth rates in Alleppey, Ernakulam and Trichur.

During winter, HYV area indicated a positive growth rate only in one district (Quilon) and there was no region where non-HYV area increased. During summer, HYV area increased only in Quilon, but non-HYV area increased in Alleppey, Ernakulam and Trichur. Thus positive growth rate of summer paddy area in Alleppey, Ernakulam and Trichur for the second period can be explained by the increased non-HYV area. For the combined seasons, positive growth rates were obtained for HYV in Quilon and Palghat and for non-HYV in Alleppey, Ernakulam, and Trichur. It can also be noticed that Trivandrum district had consistently negative growth rates for both HYV and non HYV areas during all seasons.

23/ Some of these non HYV varieties were improved local varieties.

Table 20: Growth Rates of Area Under HYV and non HYV (1975-76 to 1982-83)

District	Autumn		Winter		Summer		All Seasons	
	HYV	Non-HYV	HYV	Non-HYV	HYV	Non-HYV	HYV	Non-HYV
Trivandrum	-11.25	- 1.39	-31.52	-1.08	-24.14	-22.37	-19.50	-1.62
Quilon	24.24	-11.38	2.35	-0.56	5.17	-18.50	20.10	-5.09
Alleppey	3.37	2.61	-16.37	-2.31	-13.28	4.19	- 5.63	5.44
Kottayam	-0.30	- 1.01	- 2.61	-10.78	-19.38	-15.53	-6. 33	-4.83
Ernakulam	-4.32	1.32	- 4.64	- 0.04	- 9.15	8.47	- 4.80	1.56
Trichur	-13.64	0.84	-11.90	- 1.20	- 1.70	3.72	- 8.36	0.08
Palghat	7.24	- 5.97	15.79	- 4.50	- 3.12	-10.43	9.67	-5.32
Kerala	2.06	- 2.73	- 1.29	- 1.72	-10.04	6.63	- 1.57	-1.51

4.2.2 <u>HYV Yield</u>

The growth rate of yield for the second period during autumn, winter, summer and combined seasons were 2.46, 1.07, 1.74 and 1.70 respectively. When growth rates of HYV and non-HYV were obtained separately, it was observed that at the State level, all the rates were positive. However, during autumn, the growth rate of HYV yield (3.61%) was much higher than the growth rate of non-HYV yield (0.93%). This was also true during winter when HYV and non HYV growth rates of yield were 2.64% and 0.67% respectively. However, during summer the growth rate of HYV yield (1.13%) was much below the rate for non-HYV yield (6.68%). The observed fall in HYV area during summer can be explained, at least partially, through the relatively low increase in HYV yield. When all seasons are combined, HYV yield had a growth rate of 2.62% against the growth rate of 1.24% for non-HYV yield.

The growth rates of HYV yield was positive in all areas and seasons except in Trivandrum (autumn) and Ernakulam (summer). For non-HYV, negative growth rates were observed in Palghat (autumn and winter), Trivandrum (winter), and Kottayam (winter). During autumn, the growth rates of HYV yield exceeded those of non HYV yield only in Quilon and Palghat, but during winter this was true for Trivandrum, Quilon, Kottayam, Ernakulam, Trichur and Palghat. During summer growth rates of HYV yield exceeded non-HYV yields in Trivandrum, Quilon, Kottayam and Trichur.

Table 21: Growth rates of yield for HYV and non-HYV (1975-76 to 1982-83)

District	Autumn		Winter		Summer		All seasons	
	HYV	Non-HYV	HYV	Non-HYV	HYV	Non-HYV	HYV	Non-HYV
	(Per cent)							
Trivandrum	-0.42	1.25	1.26	-1.09	4.94	4.58	1.29	0.29
Quilon	5.78	1.60	1.07	0.30	3.09	0.60	5.21	1.50
Alleppey	0.04	1.27	0.36	6.04	1.54	2.20	0.19	7.7[illegible]
Kottayam	3.36	6.58	4.06	-0.27	5.12	1.83	1.31	1.51
Ernakulam	0.81	2.85	8.26	1.49	-3.79	1.66	-0.41	2.45
Trichur	2.30	3.18	3.16	0.92	1.41	1.02	4.34	0.60
Palghat	3.56	-1.17	0.56	-0.75	0.33	3.88	2.50	-0.77
Kerala	3.61	0.93	2.64	0.67	1.13	6.68	2.62	1.24

8.2.3 Association between HYV and Non-HYV yield

An analysis of the association between changes in HYV and non-HYV yields using data on annual changes in yield indicated that for the ten years starting 1973/74, HYV yield during autumn increased in five years and it declined in 4 years. During the five years of increased HYV yield, non-HYV yield increased for 3 years and decreased for 2 years. At the same time during the 4 years of decreased HYV yield, non-HYV yield increased for 2 years and it declined for the remaining two years. Thus during autumn the movement of HYV and non-HYV was consistent for 5 years and it was in the opposite direction for the remaining 4 years.

The movement of HYV and non-HYV yield in the districts indicated that during autumn yield movements were in the same direction for a majority of years in Trivandrum, Quilon, Kottayam, Trichur and Palghat districts. However in Alleppey and Ernakulam districts HYV yield and non-HYV yield moved in opposite directions for most of the years. In Alleppey, when HYV yield increased during 4 years, non-HYV yield increased only during 2 years, and during all the 5 years when HYV yield declined non-HYV yield increased. In Ernakulam district, dissimilarity in the yield movements were observed for 6 out of 9 years.

The movement of HYV and non-HYV yields during winter season indicated substantial disagreement. When HYV yield increased for 6 years, non-HYV yield increased only for one year and when HYV yield declined for three years, non-HYV yield declined for only one year.

Thus, of the 9 changes in yield, only two changes were in the same direction. The situation in Trivandrum, Kottayam, Ernakulam and Palghat also indicated a similar trend where the number of years when HYV and non-HYV yields moved in opposite directions exceeded the year when they moved together. However, in Quilon, Alleppey and Trichur districts, for a majority of years, the movement of HYV and non-HYV yields were in the same direction.

During summer, the movements of HYV and non-HYV yield were consistent in all cases of increased HYV yields and for thre out of four cases of decreased HYV yields. Among the districts, Quilon was the only area where the number of years of opposite movement marginally dominated the number of years with similar movements.

Thus it appears that on the whole yields of HYV and non-HYV moved in the same direction during autumn and summer, and a divergence in the movement pattern was observed during winter.

8.2.4 HYV Production

The overall growth rate of HYV production was 1.05% against the non-HYV production growth rate of -0.27%. The growth rate of HYV production was positive during autumn and winter, but it was negative during summer. At the same time the growth rate of non HYV production was negative during autumn and winter, but it turned out to be positive during summer. It may be recalled that during autumn both area and yield of HYV had positive growth rates. The positive growth rate of HYV yield during winter dominated over the negative growth rate of

Table 22: Annual Movement in HYV and non-HYV yield

District	Increase(+) or Decrease(-) in HYV yield	Increase or Decrease in Non-HYV yield					
		Autumn		Winter		Summer	
		+	-	+	-	+	-
Trivandrum	(+)	2	2	2	2	4	2
	(-)	1	4	3	2	-	3
Quilon	(+)	5	1	4	1	2	2
	(-)	-	3	1	3	3	2
Alleppey	(+)	2	2	4	2	a	a
	(-)	5	-	1	2	a	a
Kottayam	(+)	3	3	2	4	a	a
	(-)	1	2	2	1	a	a
Ernakulam	(+)	2	2	3	2	4	1
	(-)	4	1	3	1	2	1
Trichur	(+)	2	2	4	-	4	-
	(-)	-	5	2	3	1	4
Palghat	(+)	5	-	1	4	4	1
	(-)	-	4	2	2	2	2
State	(+)	3	2	1	5	5	-
	(-)	2	2	2	1	1	3

Note: + indicates an increase in yield and - indicates a decline in yield. Figures in each cell indicate the number of years when corresponding movements occurred.

a stands for incomplete data

area, but during summer the negative growth rate of HYV area dominated over the positive growth rate of yield. However, for ne HYV, the positive growth rate of yield was not sufficient to offse the negative growth rate of area during autumn and winter. Durin summer, the growth rates of both non-HYV area and yield were positi

The growth rate of production in Trivandrum was negative dur all seasons for both HYV and non-HYV. In Quilon the growth rate of HYV production was positive but the rate for non-HYV production was negative during all seasons. In Alleppey, negative growth rates we observed for HYV during winter and summer. The other cases of nega growth rates for HYV production were in Kottayam (summer), Ernakula (Autumn and summer), Trichur (Autumn, winter and summer), and Palgh (summer). Similerly for non-HYV production, negative growth rates were observed in Kottayam (winter and summer), Trichur (winter) and Palghat (autumn, winter and summer).

Thus, the observed positive growth rate of production for paddy during autumn was influenced by a high rate of growth of HYV. The negative growth during winter was influenced by the negative grow rate of non-HYV, and the negative growth rate during summer was influenced by the negative growth rate of HYV.

8.3 Irrigation

About one-third of the area under paddy in the state had access to irrigation facilities. While the dependence on irrigation was very much limited during autumn on account of the extended mons season, about half the area under paddy during winter and three-four

Table 23: Growth Rates of Production for HYV and Non-HYV (1975-76 to 1982-83)

District	Autumn		Winter		Summer		All seasons	
	HYV	Non-HYV	HYV	Non-HYV	HYV	Non-HYV	HYV	Non-HYV
	(Per cent)							
Trivandrum	-11.67	-0.14	-30.26	-2.17	-19.20	-17.78	-18.21	-1.33
Quilon	30.02	-9.79	3.42	-0.26	-13.26	-17.90	25.31	-3.59
Alleppey	3.41	3.88	-16.01	3.73	-11.74	6.29	-8.81	15.23
Kottayam	3.05	2.46	1.45	-10.21	-14.27	-13.50	-5.02	7.68
Ernakulam	-3.51	4.17	3.64	1.45	-12.94	10.13	-4.94	4.02
Trichur	-11.34	4.02	- 8.73	-0.29	- 0.29	4.74	-4.03	0.68
Palghat	10.80	-7.14	16.35	-5.25	- 2.78	-6.54	12.17	-6.09
Kerala	5.67	-1.81	1.35	-1.06	- 8.90	10.32	1.05	-0.27

area during summer were irrigated. During autumn and winter, the percentage of HYV area under irrigation exceeded the percentage of non-HYV area under irrigation, but during summer the shares of irri area in HYV and non-HYV areas remained more or less the same. Pal. district accounted for a large share of total irrigated HYV area in the state during autumn and winter. For non-HYV varieties, Ernakul and Trichur had a higher percentage of irrigated area than Palghat. During summer, Alleppey and Trichur had large areas under irrigated HYV, but for non-HYV Ernakulam and Trichur had the highest share of irrigated areas.

Table 24: Irrigated area as a Percentage of Total Area Under Paddy in Kerala

Season	Variety	Percentage of irrigated area		
		1979-80	1980-81	1981-82
Autumn	HYV	37	18	7
	Others	5	10	6
	Total	18	13	6
Winter	HYV	69	62	70
	Others	37	29	44
	Total	45	40	50
Summer	HYV	62	69	73
	Others	60	79	75
	Total	67	73	74
All Seasons	HYV	50	43	37
	Others	28	26	31
	Total	35	32	34

Irrigation is one of the critical variables influenching agricultural growth, especially for growth induced by technological change. Since Kerala has an extended monsoon season, most areas do not require extended irrigation during autumn and a part of winter. It is during summer that the role of irrigation is crucial, and as pointed out earlier, farmers might have gone back to non-HYV varieties during summer because of inadequate irrigation facilities. This is also substantiated by field observations in many areas where the field channels had insufficient water during summer.[24]

An analysis of the effectiveness of irrigation in raising the yield levels will require data on production from irrigated and unirrigated areas. Since a number of inconsistencies were observed in the existing data on production from irrigated and unirrigated areas it was decided to analyse the significance of the proportion of irrigated area in explaining the yield level. Along with the proportion of irrigated area, area under HYV, variations across the districts, and variations across the seasons were included in the analysis. The model specified for the analysis was as follows:

for each season

$$Yj = fj\,(P_{hi},\ P_{nhi},\ D_d,\ T) \text{ and} \qquad (1)$$

For all seasons

$$Y = f(P_{hi},\ P_{nhi},\ P_h,\ D_d,\ D_s,\ T) \qquad (2)$$

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24 K.N. Nair and D.Narayana has concluded that irrigation has contributed to increased yield only during autumn. Further, there is some stabilization of yield as a result of irrigation during autumn, doubtful stabilization effect during winter and negligible stabilization effect during summer. Thyagaryan and Nambiar has pointed out that when rainfall was not available during summer, solar radiation was maximum and availability of irrigation facilities was poor; and the consequence was that impact of irrigation on both yield and area expansion had been negligible.

where Y_j = Yield in jth season (j= autumn, winter, summer)

P_{hi} = Proportion of HYV area irrigated

P_{nhi} = Proportion on non-HYV area irrigated

P_h = proportion of area under HYV

D_d = dummy variable for district (Trivandrum excluded)

D_s = dummy variable for season (autumn excluded)

T = time trend

and Y = average yield

The estimated coefficients indicated the following tendencies:

(1) The coefficients of the proportion of HYV area irrigated and the proportion of non HYV area irrigated turned out to be quite close to zero and statistically insignificant for all seasons and for the combined seasons. This strengthens the earlier observation that development of irrigation did not provide a significant contribution towards increased yield.

(2) The proportion of area under HYV had a significant influence on yield during autumn and winter, but it was insignificant during summer. This is consistent with the result that during autumn and winter, the growth rates of HYV yield had been much higher than the growth rates for non-HYV yield and that during summer, the HYV yield had a smaller growth rate than the growth rate of non-HYV yield. When all seasons were combined, the proportion of area under HYV turned out to be an insignificant variable in explaining yield levels although the coefficient had a positive sign. Thus, for the annual data, proportion of HYV area was not

a significant factor explaining yield changes inspite of its significance during the autumn and winter seasons.

Variations across the districts were significant for many districts.[25] During autumn the coefficients of district dummy variables turned out to be significant in Quilon, Alleppey, Ernakulam, and Trichur, all with a negative sign. During winter the dummy coefficients were significant in Quilon, Kottayam and Trichur with a positive sign for Quilon and negative signs for the other two districts; and during summer the district dummy variables were significant in all districts, except Quilon, with a positive sign for all the districts.[26] When annual yield was considered, the district dummy variables with a positive sign turned out to be significant in Alleppey, Kottayam and Palghat.

The time trend for autumn and summer seasons and for the combined seasons turned out to be significant. Thus it is only during winter that a trend factor other than variables considered in the equation was not a significant factor in explaining variations in yield. The estimated coefficients are available in Table 25.

It may be noted that all these observations are based on yield data derived from total production and total area. The analysis was repeated for the average annual HYV and non-HYV yield separately deleting the proportion of Non-HYV area irrigated (P_{nhi}) and proportion

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25/ As mentioned earlier, across the district variations were measured by comparing with the Trivandrum district.

26/ The poor performance of summer paddy in Trivandrum district was already pointed out.

of area under HYV (P_h) from equation (2) on page 63 and modifying the variables for irrigation.

Thus the estimated equation was

Y_h = f_h (P_i, D_d, D_s, t) where

Y_h = yield of HYV or non-HYV

P_i = proportion of irrigated area

D_d = Dummy variable for district (Trivandrum excluded)

D_s = Dummy variable for season (autumn excluded)

t = time trend

The estimated equations indicated more or less the same tendencies observed for seasonal and annual yield. In particular the following conclusions can be drawn:

(1) The proportion of irrigated area turned out to be insignificant for both HYV yield and non-HYV yield. This result further confirms the observation that irrigation facilities created within the state were ineffective in raising rice yields.

(2) The district dummy variables were significant for HYV in Alleppey, Kottayam and Palghat, and for non HYV in Alleppey and Kottayam. It may be recalled that Alleppey, Kottayam and Palghat had experienced the highest growth rates of yield.

(3) The seasonal dummy variable was significant for summer HYV only. Here it may be observed that seasonal dummies remained insignificant for the pooled data for HYV and non HYV, but the significant negative coefficient of HYV yield for summer indicated the ineffectiveness of HYV's during summer.

Table 25: Estimated Regression Coefficients for Total Yields (Season-wise)

Regressors	Regression Coefficients with dependent variables as yield during		
	Autumn	Winter	Summer
Proportion of HYV area irrigated	0.0341	-0.0355	0.0218
Proportion of Non-HYV area irrigated	-0.0668	0.2352	0.1184
Proportion of area under HYV	0.5305*	0.4521*	0.1109
Dummy Variables for districts			
(i) Quilon	-0.1576*	0.1752*	0.690
(ii) Alleppey	-0.1780*	-0.0158	1.1189*
(iii) Kottayam	-0.1751	-0.1959*	0.9453
(iv) Ernakulam	-0.1972*	-0.0899	0.5293
(v) Trichur	-0.3266*	-0.1995*	0.6775*
(vi) Palghat	0.0814	0.0659	0.6041*
Time	0.0286*	0.0093	0.0475*
R^2 - Value	0.8799	0.7595	0.9132
F - Value	22.71**	9.79**	26.31**
No. of observations	42	42	36

* Significant at 5% level (two sided)

** Significant at 0.5% level.

(4) The significant time trend for both HYV and non HYV yield indicates the presence of variables other than those included in the model. The results are summarised in Table 26.

Since Palghat and Trichur districts had the largest concentration of irrigated area, the analysis of the performance of yield in relation to the irrigation facilities was carried out for these two districts separately. The results indicated that the situation in these two districts was not very much different from the overall state average. Here again it is difficult to ascertain whether the nature of results obtained are influenced by non-availability of water during critical periods.

8.4 Performance under plans

Agricultural development plans of the state had attached a high priority for improved rice production. During the Fifth Plan period, when there was explicit financial allocation according to individual crops, of the total state sector outlay of Rs.2885.7 lakhs for all crops, 1576.50 lakhs was alloted for rice. Ambitious production targets were specified for rice in each plan, but in every case the achievements lagged behind the targets. The targets specified for rice production during the last four plan periods and the actual achievement indicate the lack of any correspondence between targets and achievements - in fact between the fifth and sixth plan periods there had been absolutely no increase in actual production.

Table 26: Estimated regression Coefficients: HYV, Non HYV and average yield

Regressors	Regression Coefficients with Dependent Variables		
	Average Yield	HYV Yield	Non-HYV Yield
1. Proportion of HYV Area Irrigated	0.0258	0.0144	
2 Proportion of Non-HYV Area Irrigated	0.0421		0.1408
3 Proportion of Area under HYV	0.1345		
4. Dummy Variables for Districts			
(i) Quilon	0.0699	0.0920	-0.0077
(ii) Alleppey	0.3386*	0.5100**	0.1946*
(iii) Kottayam	0.2851*	0.3260**	0.2308*
(iv) Ernakulam	0.1572	0.1338	0.0923
(v) Trichur	0.0871	0.1758	0.0145
(vi) Palghat	0.3787*	0.4965**	0.1365
5. Dummy Variables for Season			
(i) Winter	0.0282	-0.0438	0.1145
(ii) Summer	-0.1212	-0.1614*	-0.0560
6. Time	0.0354*	0.0436**	0.0395**
R^2 - Values	0.3939	0.494	0.222
F - Values	5.79**	10.65***	3.12***
No. of observations	120	120	120

* Significant at 5% level (two sides)

** Significant at 1% level (")

*** Significant at 0.5% level (")

Note: For HYV yield and Non-HYV yield, the first two independent variables are replaced by proportion of irrigated area.

	Rice production Target	Actual	Deficit
	(1000 tonnes)		
Third Plan	1461	1006	455
Fourth Plan	2100	1352	748
Fifth Plan	2150	1273	877
Sixth Plan	1750	1208	542

Each plan had provided sufficient justifications for investments on rice improvements and some explicit targets were provided in te… of increase in area, yield and production. As indicated below for the fifth and sixth plan periods, the performance in each category was far below the targeted levels.

	Fifth Plan		Sixth Plan	
	Target	Achievement	Target	Achievement
Area (1000 hectares)				
Total area	1152	799	950	778
Additions planned	275	-78	100	-72
Production (1000 tonnes)				
Total production	2150	1273	1750	1208
Planned Additions	750	-127	475	-67
Yield/hectare(Kg.)			1850	1633

Production increases were expected through a number of activities initiated by the Government. While financial allocation and physical targets according to each crop are not specified in all plans, the Fifth plan has provided a very detailed statement regarding expansion of area under rice and intensive cultivation

Table 27: Physical and financial targets of Rice Production in Fifth Plan

(a) Programmes for the expansion of area

Programme	Physical targets: additional area (1000 hect.)	Physical targets: additional production (1000 ton.)	Financial targets: State (Rs. lakhs)	Financial targets: Institutions (Rs. lakhs)
1. Reclamation of problem areas	50	70	50	200
2. Changing cropping pattern and adoption of improved agronomic practices	50	70	116	-
3. Development or rice lands in high ranges	32	45	48.5	113.5
4. Kuttanad development	50	70	703	1995
5. Improvement of soil and water management		5	21	-
6. Kole land development	10	14	100	-
7. Minor irrigation projects	22	91		
8. Major irrigation projects	61	160		
Total	275	525	1038.5	2308.5
(b) Intensive Cultivation for Rice Production				
1. Intensive paddy development Units	152.5	61.75	275	370
2. HYV	647.5	153		1896
3. Seed multiplication programme	-	-	232	-
4. Traditional Varieties	350	12.4	-	-
5. Demonstration	-	-	18	-
6. Seminars	-	-	5	-
Total	-	232	538	2266

Source: State Planning Board, Trivandrum, Fifth Five Year Plan, draft outline, 1974-79.

Against the targeted production increase of about 750 thousand tonnes at a cost of Rs. 1576 lakhs from government sources and a still larger amount from institutions, the actual performance indicated a decline of 127 thousand tonnes during the Fifth Plan period The data for the Sixth plan has also indicated that there had been short-falls in the targets of area, yield and production. The position at the end of Sixth plan was worse than the position at the end of the fourth plan. Thus, investments in increasing rice production during the last two plan periods have virtually yielded no results in terms of increased rice production.27/

9. SUMMARY AND CONCLUSIONS

Though the major conclusions from the analysis were indicated in the appropriate sections, for convenient reference, they are brought together in this section.

1. The growth rates of area, yield and production indicated considerable variations across the districts, over seasons and over time. Area under paddy in 1983-84 was more or less the same as the area in 1960-61, but it expanded at an annual rate of 1.14% during 1960-61 to 1974-75 and then declined at an annual rate of -1.36%. In spite of this overall decline in area, some districts recorded positive growth rates of area at least for certain seasons. The overall growth rate of yield for the second period was about twice the growth rate for the first period, especially for the combined period and during

27/ Since it is difficult to determine whether these investments have prevented any decline in output (which is not explicitly mentioned), it is not possible to say whether the investment was justified.

autumn and winter seasons. The state average growth rate of yield remained more or less constant for the first and second periods. The growth rate of production, which was 2.06% for the first period, dropped to .21% for the second period: the fall in growth rate of production was maximum during summer.

For the first period all the seven districts had positive growth rates of production associated with positive growth rates of both area and yield in six districts and with positive growth rate of yield and negative growth rate of area in the seventh district . For the second period, positive growth rates of area, yield and production were simultaneously noticed in only one district; negative area, positive yield and positive production in three districts; and negative area, positive yield and negative production in the remaining three districts.

For the first period, both area and yield had the highest growth rates during summer leading to the highest growth rate of production, but for the second period production growth rate was minimum during summer. Because of the dominant role played by the negative growth rates of area over the positive growth rates of yield, negative growth rates of production were observed during winter and summer of the second period.

The variability of area for the first and second periods indicated that during autumn, variability increased in one district (Kottayam) and declined in all other districts. During winter, variability of area increased in three districts and declined in four districts; and during summer it increased in five districts. In general, most areas had experienced reduced variability of yield. The stagnation in production was associated with reduced variability of output levels over time.

The reductions in area and variability indicated that paddy land was either converted to perennial crops or there was a tendency to keep land fallow for longer periods. The reduced rate of variability in rice production was influenced by reductions in the fluctuations of both area and yield.

During the first period, contributions of area accounted for most of the changes in output during winter and summer; and yield was the dominant factor during autumn. For the second period, yield dominated all periods. While yield was the dominant factor influencing production changes during autumn for both periods separately and for the combined period, area changes dominated in production changes during winter and summer for both periods. In the districts where output levels had declined over time, reduction in area emerged as the dominant factor. Thus the observed stagnation in annual production in the state was the net result of a number of adjustments of positive and negative effects of area and yield across seasons and districts. When annual changes in production were analysed yield was the dominant factor responsible for production changes in a number of years.

The changes in both paddy and coconut prices had influenced the adjustments in paddy area. Though paddy area was inelastic with respect to both paddy and coconut prices, both had a statistically significant influence on acreage adjustments of paddy. In the short run, wage rate and paddy price had influenced the farmers decision of retaining land fallow. Thus increased wage rate and disproportionate increase in paddy price expanded current fallow, but this tendency together with increased relative price of coconut influenced farmers to switch over from paddy to coconut cultivation.

During autumn there had been a tendency to switch over to HYV paddy from the traditional varieties and during summer the tendency was in the reverse direction. During autumn the growth rate of HYV yield was substantially higher than the non HYV growth rate, but during summer HYV yield had a much lower growth rate than the non HYV rate. Thus, while HYV adoption was profitable during the monsoon period, it was not the case during summer: inadequate irrigation facilities could be a major limiting factor in expanding HYV coverage during summer.

The proportion of irrigated area (both HYV and non-HYV) turned out be a non significant variable in explaining paddy yield. While the proportion of area under HYV had a significant influence on yield during autumn and winter, it was not significant during summer. Because of this difference, in the annual data HYV area was not found to be an important variable in explaining rice yields. While inter district variations in paddy yield had been significant in many situations, inter seasonal variations were not significant.

In terms of prospects for increased paddy production in the state, it is unlikely that area under paddy can be increased. While maintaining the parity between paddy prices and wage rates might prevent farmers from keeping land fallow, because of the pric differentials price incentives are unlikely to be effective in shif ing cropping pattern in favour of paddy. At the same time, there is scope for increased production through changes in technology, particularly HYV and fertiliser application. However, this can be effective only if irrigation facilities, both surface and ground water, are utilised efficiently. Thus the strategy for increased rice production in Kerala should be based on improved utilisation of irrigation facilities, use of HYV and efforts to maintain farm level income either through remunerative output prices or throuh stable cost of production. In this connection, it is also imporant to explore the possibilities of increasing yield through insitutional mechanism, particularly consolidation of holdings.[28/]

28/ See K.N. Raj, (1985)

.Alagh and P.S.Sharma 1980	Growth of Crop Production: 1960-61 to 1978-79, to it Decelerating? Indian Journal of Agricultural Economics XXXV(2) April-June 1980 p. 104 - 118.
. Dandekar, 1980	Introduction to the Seminar on Data Base and Methodology for the Study of Growth Rates in Agriculture, Indian Journal of Agricultural Economics, XXXV(2), April-June 1980, p. 1-12.
.S. George, 1982	Agricultural Price Movements in Kerala in P.P.Pillai (ed) Agricultural Development in Kerala, Agricole Publishing Academy, New Delhi.
.S.Minhas and .Vaidyanathan 1965	Growth of Crop Output in India 1951-54 to 1958-61, An Analysis by Component Elements, Journal of the Indian Society of Agricultural Statistics XVII (2) December, 1965 p. 230-252.
.N.Nair and arayana 1983	Linkage of Irrigation with Development; Kerala Experience, Centre for Development Studies Working Paper 161, Trivandrum.
am Narain 1977	Growth and Productivity in Indian Agriculture, Indian Journal of Agricultural Economics, XXXII(1) January - March 1977, p. 1-24.
erlove, Marc 1958	Distributed Lags and Estimation of Supply and Demand Elasticities, Theoretical Considerations, Journal of Farm Economics, 40(2), 302-11
th, Nilakanta 1980	A note on Agricultural Production in India during 1955-78, Indian Journal of Agricultural Economics XXXV(2), April-June 1980, p. 94-103.
G.K.Panikar 1980	Recent Trends in the Area and Production of Rice in Kerala, Centre for Development Studies Working Paper 116, Trivandrum.

P.P. Pillai 1982	Growth of Agricultural Output in Kerala Since Independence, in P.P. Pillai (ed), Agricultural Development in Kerala, Agricole Publishing Academy, New Delhi.
K.N. Raj 1985	Natural Resources and Decentralised Development in Kerala, Paper presented at the Annu Conference of KSSP, Kozhikode, February 8,
C.H.H.Rao 1975	Technological Change and Distributions of Gain in Indian Agriculture, The Mcmillan Co, of India,
S.R.Sen 1967	Growth and Instability in Indian Agricultur Agricultural Situation in India XXI (10)
State Planning Board	Fifth Plan Draft Outline, Kerala State Planning Board.
V.Thyagarajan and K.V.Nambiar 1983	Rice Production in Kerala, Paper presented the Seminar on Stagnation of Rice Producti in Kerala, Trivandrum.
Vidyasagar 1980	Decomposition of Growth Trends and Certain Related Issues, Indian Journal of Agricultu Economics, XXXV(2), April-June 1980, p.42-